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Patent ~~Claims~~

1. An electronic device having at least one microscopically small contact area (1) for an electronic circuit having interconnects (2) on a surface (3) of a substrate (4), characterized in that the contact area (1) additionally has a three-dimensionally extending microscopically small contact element (5) which is connected to the contact area (1) in one piece and integrally.

2. The electronic device as claimed in claim 1, characterized in that the contact area (1) is arranged opposite a contact connection area of an intermediate carrier with flat conductors.

3. The electronic device as claimed in claim 1, characterized in that the substrate (4) is a semiconductor chip (6) or a semiconductor wafer (7) and the electronic circuit is at least one integrated circuit in that region of the semiconductor chip (6) or of the semiconductor wafer (7) which is near the surface.

4. The electronic device as claimed in claim 1, characterized in that

the electronic circuit with interconnects (2) has a multiplicity of contact areas (1) which are respectively arranged on one of the ends of the interconnects (2).

5. The electronic device as claimed in claim 1, characterized in that the contact element (5) is elastically deformable.

6. The electronic device as claimed in claim 1, characterized in that the contact element (5) is preformed at a solid angle which deviates from the orthogonal orientation.

7. The electronic device as claimed in claim 1, characterized in that the contact element (5) is prebent at a solid angle which deviates from the orthogonal orientation.

8. The electronic device as claimed in claim 1, characterized in that the length of the contact element (5) is at least 5% greater than the largest bulging of the surface (3) of the substrate (4).

9. The electronic device as claimed in claim 2, characterized in that

the length of the contact element (5) is at least 5% greater than the largest distance between contact area (1) and contact connection area.

10. The electronic device as claimed in claim 1, characterized in that the length of the contact element (5) is at least 5% greater than the largest length difference with regard to the centrally located neutral point of the substrate (4) in the event of maximum thermal cycling.

11. The electronic device as claimed in claim 2, characterized in that the length of the contact element (5) is at least 5% greater than the largest length difference between substrate (4) and intermediate carrier relative to the centrally located neutral point of the substrate (4) in the event of maximum thermal cycling.

12. The electronic device as claimed in claim 1, characterized in that the contact area (1) and the contact element (5) are produced from an identical metal alloy.

13. The electronic device as claimed in claim 1, characterized in that

the contact area (1) is produced from an aluminum alloy and the contact element (5) is produced from a gold alloy.

14. The electronic device as claimed in claim 1, characterized in that the contact area (1) is produced from an aluminum alloy and the contact element (5) is produced from a copper alloy.

15. The electronic device as claimed in claim 1, characterized in that the contact element (5) is designed as a contact pin (16).

16. The electronic device as claimed in claim 11, characterized in that the contact pin (16) has a diameter which is less than or equal to half the shortest linear dimension of the contact area (1).

17. The electronic device as claimed in claim 11, characterized in that the contact pin (16) has a contact head (8) on its end which is remote from the contact area (1).

18. The electronic device as claimed in claim 15, characterized in that the contact head (8) has a nickel and/or gold coating.

19. The electronic device as claimed in claim 15, characterized in that the contact head (8) has a coating made of a solderable metal alloy.

20. The electronic device as claimed in claim 15, characterized in that the contact head (8) is composed of solder.

21. The electronic device as claimed in claim 1, characterized in that the contact element (5) is designed as a contact spring (17).

22. The electronic device as claimed in claim 21, characterized in that the contact spring (17) is designed as a contact leaf spring (18), one contact leaf spring end (19) being connected to the contact area (1) and the free contact spring end (20) extending three-dimensionally.

23. The electronic device as claimed in claim 21, characterized in that the contact spring (17) extends three-dimensionally at a solid angle α which is smaller than the orthogonal from the contact area (1).

24. The electronic device as claimed in claim 22, characterized in that the width of the contact leaf spring (18) corresponds to the width of the contact area (1).

25. The electronic device as claimed in claim 22, characterized in that the contact leaf spring (18) is tapered at its free leaf spring end (20) and has a square cross section.

26. The electronic device as claimed in claim 21 , characterized in that the contact spring (17) is provided with gold and/or a nickel coating at its free end.

27. A method for producing an electronic device having at least one microscopically small contact area (1) for an electronic circuit having interconnects (2) on a surface (3) of a substrate (4), the contact area (1) additionally having a three-dimensionally extending microscopically small contact element (5) which is connected to the contact area (1) in one piece and integrally, and the method comprising the following method steps:

a) Patterning of a conductive layer (9) on a surface (3) of a substrate (4) to form interconnects (2) and microscopically small contact areas,

b) Application of a passivation layer (15) to the patterned conductive layer (9),

c) Opening of contact windows in the passivation layer (15) in order to uncover the contact areas,

d) Application of a closed conductive layer (10) in order to connect the contact areas,

e) Application of a masking layer (11) to the closed conductive layer (10),

f) Patterning of the masking layer (11) with through openings (12) to the closed conductive layer in the region of the contact areas (1),

g) Filling of the through openings (12) with conductive material,

h) Removal of the masking layer (11),

i) Removal of the closed conductive layer (10).

28. The method as claimed in claim 27,
characterized in that
the patterning of a conductive layer (9) and the opening of the contact windows in the passivation layer are effected by means of photolithography methods.

29. The method as claimed in claim 27,

characterized in that

the application of a closed conductive layer (10) is effected by means of vapor-deposition technology, sputtering technology or deposition technology.

30. The method as claimed in claim 27,

characterized in that

a copper alloy layer is applied as the closed conductive layer (10).

31. The method as claimed in claim 27,

characterized in that

the application of a masking layer (11) to the closed conductive layer (10) is effected by means of spinning on, spraying on or by means of immersion technology.

32. The method as claimed in claim 27,

characterized in that

a photosensitive dielectric is applied as the masking layer (11).

33. The method as claimed in claim 27,

characterized in that

the patterning of the masking layer (11) with through openings (12) is effected by means of photolithography.

34. The method as claimed in claim 32, characterized in that, in order to produce a three-dimensionally angled contact element (5), the masking layer (11) made of a photosensitive dielectric is exposed at a solid angle with respect to the contact area (1).

35. The method as claimed in claim 27, characterized in that a resin layer is applied as the masking layer (11).

36. The method as claimed in claim 27, characterized in that the masking layer (11) is provided with through openings (12) to the contact areas (1) by means of laser removal technology, ion beam sputtering or plasma etching.

37. The method as claimed in claim 27, characterized in that the filling of the through openings (12) with conductive material is effected by means of electrodeposition.

38. The method as claimed in claim 27, characterized in that the filling of the through openings (12) is effected by means of electroless deposition technology.

39. The method as claimed in claim 27, characterized in that the removal of the closed conductive layer (10) is effected by means of etching technology.

40. The method as claimed in claim 27, characterized in that contact heads (8) are formed by means of electrodeposition or in an electroless manner.

41. The method as claimed in claim 27, characterized in that the spaces between the contact elements (5) are potted.

42. The method as claimed in claim 41, characterized in that the potting of the spaces between the contact elements (5) is effected by means of spraying technology or injection-molding technology.

43. The method as claimed in claim 27, characterized in that contact heads are uncovered after potting of the interspaces (13) between the contact elements (5).

44. The method as claimed in claim 43, characterized in that contact heads are uncovered by means of laser removal technology.

45. The method as claimed in claim 27, characterized in that the contact heads (8) are coated with nickel and/or gold.

46. A method for producing an electronic device having at least one microscopically small contact area (1) for an electronic circuit having interconnects (2) on a surface (3) of a substrate (4), the contact area (1) additionally having a three-dimensionally extending microscopically small contact element (5) which is connected to the contact area (1) in one piece and integrally, and the method having the following method steps:

a) Patterning of a metal sheet (21) preferably made of a copper alloy with patterns (22), the structure having a multiplicity of uncovered contours of contact springs (17) which are connected to the metal sheet (21) by a desired breaking point (23), the uncovered end (24) of the contact spring contour (25) corresponding in size, arrangement and position to the contact areas (1) of a substrate (4),

b) Alignment and pressing of the patterned metal sheet (21) onto a substrate (4) with a multiplicity of contact areas (1),

the uncovered ends (24) of the contact spring contours (25) being pressed onto the contact areas (1),

c) Heating of the metal sheet (21) and of the substrate (4) for the purpose of bonding the uncovered ends (24) of the contact spring contours (25) to the contact areas (1),

d) Cooling and stripping-off of the metal sheet (21), leaving behind three-dimensionally extending, bonded or soldered contact springs (21) on each of the contact areas (1).

47. The method as claimed in claim 46,

characterized in that

the uncovered ends (24) of the contact spring contours (25) are coated with a nickel and/or a gold layer before being pressed onto the contact areas (1) of a substrate (4).

48. The method as claimed in claim 46,

characterized in that

the contact spring contours (25) are coated with a solderable metal alloy in the region of the desired breaking points (23).

49. The method as claimed in claim 46,

characterized in that

a spring-elastic material having a thickness between 30 and 100 μm is used as the metal sheet (21), which material is provided with a solderable tin layer.

50. The method as claimed in claim 46, characterized in that, before the pressing-on of the metal sheet (21), the contact spring contours (25) are soft-annealed in predetermined regions, preferably in their central region (26).

51. The method as claimed in claim 46, characterized in that a soft metal sheet is used and, after the metal sheet (21) has been stripped off, the residual three-dimensionally extending contact structures are heat-treated to the desired spring property of the contact springs (17).

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